ON *TROMBICULA MINOR* BERLESE, 1905.

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(Three Text-figures.)

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Synopsis.

Trombicula minor Berlese 1905 is the genotype of *Trombicula*, but unfortunately no specimens of *T. minor* are available. This paper records all that is known of the species; the synonymy is discussed and a full list of references is given.

I. The Genotype.

The genus *Trombicula* Berlese, 1905, is of considerable medical importance, since among its members are all the known vectors of tsutsugamushibyo (Japanese river fever, mite typhus, scrub typhus). *Trombicula minor* Berlese, 1905, is the genotype of *Trombicula*, and hence is of comparable acarological importance. But, unfortunately, there are no specimens of *T. minor* at present available, and it has been deemed advisable to assemble in one place all that is known of the species.

The original specimens were collected by Professor Kraepelin, then Director of the Hamburg Museum, among bat guano in caves at Tjompea, in Java (Willmann, 1941, p. 135: "Das Präparat von *Trombicula minor* ist mit folgender Fundortsangabe versehen: 'Tjompea, Java, 19.III.1904, aus Höhlenguano gesiebt.' "). They were described by Antonio Berlese (Berlese, 1905, p. 155: "*Trombicula minor* n. sp."); it is apparent that there were two complete specimens (Berlese, 1905, p. 156: "Duo vidi exempla collecta ad Tjompea", and Willmann, 1941, p. 133: "Im Präparat findet sich noch ein zweites Exemplar ohne Eier") and some fragments (Berlese, 1912, p. 94: ". . . io non possideo che alcuni frammenti di questo acaro, . . .").

The two complete specimens were lodged at the Hamburg Museum (Berlese, 1912, p. 94: "I tipici si trovano al museo di Amburgo; . . ."), and Berlese retained the fragments himself (*supra*).

In 1941, Herr Carl Willmann, of Bremen, examined the Hamburg specimens and redescribed them (Willmann, 1941, p. 132: ". . . habe ich eine Nachuntersuchung des Typenexemplares vorgenommen. Das Präparat wurde mir vom zoologischen Museum in Hamburg zu diesem Zwecke liebenswürdigerweise bereitwilligst zur Verfügung gestellt.").

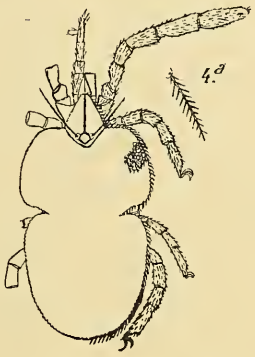
In 1950 I visited Hamburg, intending to study the genotype myself; Professor F. Weyer, Director of the Bernhard-Nocht-Institut für Schiffs- und Tropenkrankheiten, most kindly made inquiries for me at the Hamburg Museum and found that the two specimens of *T. minor* had been destroyed (Weyer, personal communication, 25th May, 1950: "Ich habe sofort mit dem Zoologischen Museum telephoniert und erfuhr, dass die Typen und Paratypen von *Trombicula minor* durch den Krieg zerstört sind.").

I then consulted Herr Carl Willmann, of Bremen. He reviewed the above facts and pointed out that *T. minor* is unalterably the genotype of *Trombicula*, according to Article 30c of the International Rules of Zoölogical Nomenclature (in Schenk and McMasters, 1936, p. 34: "c) A genus proposed with a single original species takes that species as its type."). He also pointed out that nothing but a suitable topotype would serve to replace the lost genotype (cf. Schenk and McMasters, 1936, p. 8: "When the original type material of a species is lost, the reviser of the species should choose a neotype. The neotype must be a specimen from the type-locality of the species and certainly must agree with the original figure and description.").

Later, I made inquiries at the Instituto Superiore de Sanita in Rome, but could secure no information about the fragments retained by Berlese.

Dr. Cornelius B. Philip, of the Rocky Mountain Laboratory in Montana, very kindly allowed me to see the correspondence he has had with Dr. A. Diakonoff, of the Zoological Museum at Buitenzorg. Dr. Diakonoff, at Dr. Philip's request, had secured some material from the caves at Tjompea, and this was examined at the laboratory; unfortunately there were no Trombiculae found. It is hoped that further attempts will be made.

There the matter rests until such time as a suitable topotype is found and accepted. Its acceptance must be based on its agreement with Berlese's original description and illustration (1905); but Berlese's 1912 work, and especially the additional details reported by Willmann in 1941, must also be given full consideration. Berlese's fragments, if they can be located, may be of some help, even though in 1912 he said of them: ". . . ho potuto rilevare solo i caratteri accenati, ma non si trova la base del capotorace



Text-figure 1.—*Trombicula minor* Berl. (Prona; 4*a*, corporis seta.). (After Berlese, 1905, Pl. xv, figs. 4, 4*a*.)

coll'area sensilligera per potere vedere se esistono o meno gli occhi". For completeness, and for the convenience of future workers, I include here the relevant quotations and the illustrations from both these writers:

Berlese, A., 1905: *Redia*, II, ii, 155: "Acari di Giava: *Trombicula minor* n. sp.: Albida (?), elongata, in medio circiter corpore valde coarctata. Crista metopica posterius in arcam subrhombicam desineno, utrinque longe unipilam (pili isti curte barbatuli). Pedes antici caeteris longiores et robustiores, tarso longe conico. Palpi longiores, ungue valido et longo, interne ad unguem spinis longis et robustis duabus, tentaculo autem sat longo cylindrico. Derma corporis crasse et aeque granuloso-verruculosum ex verruca quaque pilus exoritur qui sat brevis est, utrinque barbatulus. Pedes pilis conformibus dense obtecti (Fig. 4). Ad 680μ long."

Berlese, A., 1912: *Redia*, VIII, i, 94: "*Trombicula minor* Berl. 1905. Albida. Pili trunci curtiores (20–25μ). Tarsi antici bene conici, acuti, tibiae vix curtiores, duplo et dimidio longiores quam lati. Palpi graciles, longi, ungue exili et bene longo, falcato, spinis internis duabus. Ad. 680μ long."

"Inoltre anche il palpo é diverso [from *T. mediocris*]. Esso é piú smilzo, con unghia molto piú lunga e sottile, e con due sole spine alla sua radice, dal lato interno."

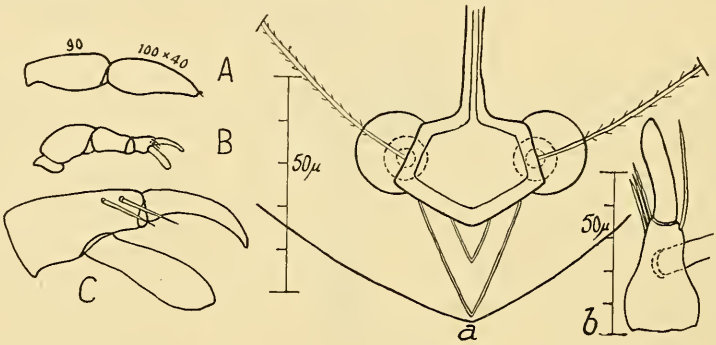
"I tarsi anteriori, . . . sono conici e molto stretti nella parte apicale; misurano 100μ di lunghezza per 40μ di larghezza. Inoltre piccola é la differenza di lunghezza tra i tarsi anteriori e le tibie, poiché queste sono lunghe 90μ cioé piú corte (della decima parte) del tarso."

Willmann, C., 1941: "Zool. Anzeiger, CXXXIII, v/vi, 131: "Nach BERLESE (1905) hat die Palptibia innen neben der Endkralle 2 starke Dornen."

"Ich konnte an dem Typenexemplar die Palpen leider nur in Dorsalansicht untersuchen, habe aber feststellen können, dass BERLESE sich augenscheinlich geirrt hat, . . .

An dem Typenexemplar ist trotz der ungünstigen Lage deutlich zu erkennen, dass an der Innenseiten 3 'Dornen' . .. vorhanden sind. Sie stehen aber so dicht nebeneinander, dass es von oben aussieht, als wenn sie aus einem gemeinsamen Grundteil herauskämen. Es ist aber anzunehmen, dass es sich in Wirklichkeit um 3 einzelne, starke Borsten handelt, die so dicht neben- und etwas untereinander stehen, dass sie den Eindruck einer dreifach gegabelten Borste hervorrufen. Eine dreizinkige Gabel an dieser Stelle wäre für die gesamte Familie der Trombidiidae etwas ganz Absonderliches. An der Aussenseite der Endkralle steht eine lange, einfache Borst (Abb. 1b)."

"BERLESE war also selbst im Zweifel, ob die Spezies Augen habe oder nicht. Zu einem einwandfreien Ergebnis hat die Untersuchung des Typenexemplares auch nicht geführt. Ich habe die Area sensilligera mit Immersionssystem untersucht und konnte folgendes feststellen: Die lange, gerade Crista hat in der Mitte eine Längsrinne. Sie erweitert sich hinten zu einer sechseckingen Area sensilligera (Abb. 1a). Die Haargruben, Trichobothrien nach GRANDJEAN, liegen direkt am Aussenrande der Areole. Aus ihnen



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Text-fig. 2.—*Trombicula minor* Berl. (A : B : : 100 : 1). A, tarso e tibia 1° paio; B, palpo; C, apice del palpo molto più ingrandito (lato interno). After Berlese, 1912, p. 94.

Text-fig. 3.—*Trombicula minor*. *a*, area sensilligera; *b*, palptibia, dorsal. After Willmann, 1941, p. 134.

regen die langen, steifen, feinbewimperten Sinneshaare heraus. Sie sind 107μ lang, während die ganze Criste 127μ lang ist. Diese deutlich zu erkennenden, von einem Kreis umschlossenen, vertieften Haargruben sind nach aussen umgeben von einem stark gewölbten, vollig glatten Wall, der etwa zwei Drittel eines Kreisumfanges einnimmt. BERLESE zeichnet es 1905 so, als wenn neben dem schräg nach vorn gerichteten Seitenrande der Area eine starke, kreisformige Trichobothrie vorhanden sei, aus deren Mitte die Sinneshaare hervortreten. Das ist aber nicht der Fall. Man sieht die Haargruben erst bei tieferer Einstellung des Mikroskoptubus. Sie liegen exzentrisch zu der Umwallung und sind halb unter die Areole und den stark gewölbten äusseren Wall geschoben. Dieser Wall jederseites des Seitenrandes der Area macht den Eindruck, als ob es sich wohl um ein Auge handeln könne. Mit Bestimmheit möchte ich das aber nicht behaupten. Die Lage der Augen direkt am Seitenrande der Sinnesareole wäre nicht besonders auffällig, findet sich doch eine ähnliche Bildung bei der Gattung Trombiculoides JACOT, bei der die als Augen angesprochenen Organe nur in einer starken Vorwölbung des Seitenrandes der Sinnesarea bestehen, also noch weniger hervortreten als hier. Das Eigenartige ist aber die Lage der Trichobothrien zu den 'Augen'. Die Sinnesborsten kommen genau auf der Grenze der Areole und der 'Augen' heraus, und die kreisförmigen Umgrenzungen der Haargruben schieben sich, wie schon gesagt, sowohl unter den Seitenrand der Areole als auch unter die vermeintlichen 'Augen' hinunter."

Lest there be any doubt about the status of Berlese's original specimens, Berlese himself first started this hare (1912: ". . . e non é certo il caso di pensare ad individui giovani."), and Ewing followed him (1920 and 1938)—I include here Willmann's state-

ment (1941): "Es handelt sich bei dem Typenexemplar von *Trombicula minor* BERL. auf keinen Fall um eine Nymphe, es ist ein adultes Tier, in dessen Körper deutlich ein vollausgebildetes Ei zu erkennen ist."

II. The Synonymy of Trombicula minor.

I have been largely responsible for creating considerable confusion concerning the taxonomy of *T. minor* and certain other Trombiculae, and it is now necessary for me to explain and clear up the situation as far as I can.

In 1939 I described a larval mite from New Guinea, *Trombicula hirsti* var. *buloloensis*, and stated that it was probably only a local variant of *T. hirsti* Sambon, 1927. In the same year I bred nymphs of this species and published (1939*a*) the statement: ". . . as far as can be determined, these nymphs are identical with *Trombicula minor* Berlese, 1904 [sic]."

Womersley (1939) considered certain collateral evidence from Queensland mites and approved the above identification. He also discounted the slight differences between *T. hirsti* Sambon and *T. hirsti* var. *buloloensis*, and pronounced them to be synonymous.

In 1940 I reviewed the literature and reached the following conclusions:

1. That *T. pseudoakamushi* Hatori, 1919 (*nec* Tanaka, 1916), was synonymous with *T. mediocris* Berlese, 1912.

2. That *T. pseudoakamushi* Hatori was also synonymous with *T. hirsti*.

3. And therefore that, because of the assumption that *T. hirsti* was a synonym of *T. minor*, both *T. pseudoakamushi* Hatori and *T. mediocris* were also synonyms of *T. minor*.

I used this synonymy in several subsequent papers (1939*b*, 1940*a*, 1940*b*, and 1941). It was adopted by many writers, but others did not accept it as proved, and Ewing (1944), reviewing Willmann's paper on the genotypes of *T. minor*, concluded that *T. hirsti* var. *buloloensis* was distinct from *T. minor*.

In 1950 I took some nymphs of *T. hirsti* var. *buloloensis* to Herr Carl Willmann in Bremen. He examined them, and from comparison with his notes, sketches, and recollections of *T. minor* he was able to state authoritatively that the two species were quite distinct. This being so, the argument that *T. mediocris* is synonymous with *T. minor* falls down—there is no other evidence beyond Miyajima's very vague suggestion (1920). Thus *T. minor* Berlese, 1905, stands alone, without any synonyms.

It is obviously necessary also at this stage to dispose of all those names which have formerly been regarded as synonyms of *T. minor*. That *T. pseudoakamushi* Hatori is synonymous with *T. hirsti* can hardly be doubted; Hirst (1929) and Gater (1932) provide overwhelming evidence in support. That Radford (1942) listed *T. pseudoakamushi* Hatori, 1919, as a valid species, without any reference whatever to *T. pseudoakamushi* Tanaka, 1916, means nothing; Womersley and Heaslip (1943) list "*T. hatorii* sp. nov.", with *T. pseudoakamushi* Hatori as its synonym, but their discussion is not convincing.

But that *T. pseudoakamushi* Hatori is synonymous with *T. mediocris* is probably not so. The suggestion first came from Kawamura and Yamaguchi (1921), but there is no supporting evidence available. Walch (1925) stated that his nymph of "*T. pseudoakamushi* (variatio *deliensis* ?)" resembled *T. mediocris*, but his illustration of the crista is clearly different from Berlese's (1912). Thus it would seem that *T. mediocris* Berlese, 1912, must also be regarded as standing alone, without synonyms.

This leaves *T. hirsti*. The situation here has become complicated because of the work of Wharton (1946), Philip and Woodward (1946), and Philip and Kohls (1948). They regard *T. hirsti* var. *buloloensis* as synonymous with *T. wichmanni* (Oudemans, 1905) Hirst, 1917. This may well be—but the corollary would be that *T. hirsti* is therefore also synonymous with *T. wichmanni*, for there is as little variation on the one side as on the other. Moreover, Philip (1947) mentions that *T. hatorii* (= *T. pseudoakamushi* Hatori, *non* Tanaka) is likely to prove a synonym of *T. wichmanni*, which would complete the circle. However, I feel that this can wait until actual specimens

from all areas have been properly compared, and with the reservation that perhaps *T. hirsti* and its synonyms will ultimately become in turn synonyms of *T. wichmanni*. I offer the following synonymy for *T. hirsti*:

TROMBICULA HIRSTI Sambon, 1927.

(Sambon, L. W., 1927: *Ann. Mag. Nat. Hist.*, IX, xx, 157.)
T. pseudoakamushi Hatori, 1919 (*nec* Tanaka, 1916).
T. pseudoakamushi (variatio *deliensis*) Walch, 1924.
T. pseudoakamushi (variatio *deliensis* ?) Walch, 1925.
T. hirsti var. *morobensis* (*nom. nud.*) Gunther, 1938.
T. hirsti var. *buloloensis* Gunther, 1939.
T. hatorii Womersley and Heaslip, 1943.
T. minor var. *deliensis* Walch, 1923, in Womersley and Heaslip, 1943.
T. hirsti var. *boloensis* [*laps. cal.*] Farner and Katsampes, 1944.
T. buloloensis Gunther, 1939, in Blake *et al.*, 1945.
Eutrombicula buloloensis (Gunther, 1939) Wharton, 1946.

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